COAL MINING BUILDING BLOCK PROFILE [1]

Prepared for:

Economic Development Branch
BC Ministry of Sustainable Resource Management

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BUILDING BLOCKS FOR ECONOMIC DEVELOPMENT & ANALYSIS

PREFACE

PURPOSE

Building Blocks have been conceived and developed by the Economic Development Branch of the Ministry of Sustainable Resource Management, under the guidance of Nancy South, Manager Economic Analysis, as an analytical tool that supports British Columbia coastal and land and resource use planning and decision-making and economic development initiatives. The Blocks contain concise business and sector information for a broad range of resource-based business types in BC. At this point, there are more than 30 Blocks either complete or in draft form. Several more Blocks have been identified as high priority by planning tables and other client groups. Additional Building Blocks will be developed over time, and some Blocks may be updated. For the most current Building Blocks, please see the Ministry of Sustainable Resource Management website, at: http://srmwww.gov.bc.ca/rmd/ecdev/

ACKNOWLEDGEMENTS

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BENEFITS

Building Blocks are expected to provide the following general benefits:

- Increase efficiency and more informed decision-making by providing readily accessible, credible information to planning and economic development processes;
- Improve the consistency of economic information across planning areas;
- Support economic analysis and decision-making that occurs outside formal coastal and land use planning processes; and
- Provide linkages between economic analysis and other social and environmental analytical tools (through identifying resource requirements to support economic activities and general compatibilities with other sectors and values).

LIMITATIONS

Every effort has been made to ensure that the information contained in Building Blocks is accurate and consistent. Approved, credible data sources are the foundation for Building Blocks. All Blocks were reviewed by sponsoring agencies and other experts. However, users are cautioned that information is used at their own risk, and that the authors and sponsors are not liable for any damages. Any conclusions or interpretations by the authors are not intended to represent government policy. Also, note that Building Blocks do not provide site specific information nor do they consider requirements for sustainability (social, community, environmental).

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RECOMMENDED REFERENCE/CITATION

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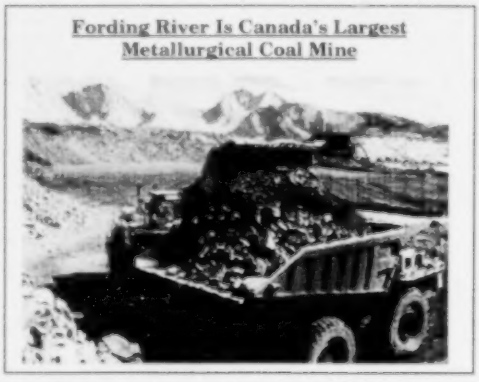
1.0 OVERVIEW

1.1 Description

- Beginning in the mid-1800s, with coal mining on Vancouver Island, BC has become Canada's second largest coal producing province.
- BC coal is produced in three areas in BC; the Kootenays, the Northeast and on Vancouver Island – BC produces high quality metallurgical (coking) coal and thermal coal – BC uses very little coal domestically, slightly over 1 percent of its production (365,815 tonnes) in 2001.[2]
- Coal markets have recently improved and BC production has increased over the last three year.[3]

Type	1999	2000	2001
	(M tonnes)	(M tonnes)	(M tonnes)
Metallurgical	23	24.3	26
Thermal	1.2	1.1	1.2
Total	24.2	25.4	27.2

1.2 Location of Deposits


Fording River Is Canada's Largest Metallurgical Coal Mine

- The major coalfields in BC follow a northwest belt, paralleling the Rocky Mountains foothills along the Northeast and Southeast parts of the Province – other coalfields are found on Vancouver Island and in the BC Interior (see Section 7.0 for map of BC coalfields.)
- The East Kootenay coal area is comprised of three coalfields extending from the Montana border northward, known as the Flathead, Crowsnest, and Elk Valley coalfields – the Kootenay coalfields have five coal mines with proven in-place reserves of over 1.3 billion tonnes – the East Kootenay area contains the most important coalfields in the BC, having produced over 500 million tonnes since 1898.
- The second most important coalfield is in the Peace River area, which extends for 400 kilometres through the Northeast part of the province – the Northeast underwent large-scale development in the 1970's and 1980's, with construction of the Tumbler Ridge town site, major rail and port facilities, and the Quintette coal mine (which closed in 2000)[4] and Bullmoose coal mine.
- Vancouver Island has the Suquash, Comox and Nanaimo coalfields – the Quinsam coalmine on Vancouver Island produces thermal coal, primarily for export, although some is used domestically.

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1.3 Mine Development

- Mine development is reviewed based on a large open pit "clean coal" mine located in the Northeast producing about 4.0 million tonnes/yr. of metallurgical coal and a 200,000 tonnes/yr. of thermal coal annually.
- Clean coal refers to coal that has been washed to remove coal fines – this reduces ash content and dust during handling, which improves coal quality and price.
- Coal mining development is also likely in the East Kootenays in close proximity to existing infrastructure, which is important to project economics.
- There are several steps in the production of clean metallurgical coal, involving mining the coal seams and processing to produce a product, in the size range 0.15 mm to 40 mm, for shipment to an overseas steel mill.
- The project would include a large open-pit mine using shovels and trucks, a crushing plant, a preparation plant including washing, classification, cycloning, flotation, filtering, drying and load out facilities, including storage silos and train loaders.
- Infrastructure would include site access roads, rail lines, power supply, tailings impoundment, reject and waste rock dumps, and ancillary facilities, such as a construction camp, warehouses, repair shops, offices and a small airstrip.
- For this example, a new coal mine is assumed to be located about 70 km from Tumbler Ridge, which would require 70 km power line and road and rail connections to the existing BC Rail and highways at Tumbler Ridge.
- The majority of the operations personnel will be able to live in Tumbler Ridge and that no permanent camp or townsite would be required.
- Mine development typically involves five major phases: (1) Exploration and Development, (2) Mine Construction, (3) Mine Operation, (4) Closure, and (5) Site Rehabilitation.

1.4 Exploration and Development

- Exploration typically takes 5 to 10 years and includes diamond drilling, geochemistry, trenching and sampling – these activities yield information that leads to a pre-feasibility study.
- Further exploration may proceed to build confidence to support a project decision – this requires further diamond drilling, bulk sampling, metallurgical testing, pilot plant work and preparation of a final feasibility study to justify the project.
- For the exploration and development phase, there is a progression in terms of land use, from small multiple targets spread over a large area to smaller areas of more intensive work.

1.5 Design and Construction

- This step involves detail design and construction of the mine (e.g., 1 to 3 years), which involves road and rail access, site preparation, engineering, procurement, construction, commissioning and start-up.

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1.6 Operation

- This includes mining the coal seams, operation of the preparation plant, silo storage and train loading, waste rock and tailings management, environmental monitoring, inspection and enforcement, including, water quality, air quality, and fish and wildlife management.
- The operation of the mine (20-yrs.) supports a wide range of suppliers, including electricity and utility suppliers, equipment, camp management, food, fuel, chemicals, airstrip and air service, in addition – the access road can used by others (e.g., forestry, recreation, prospectors).

1.7 Closure and Reclamation

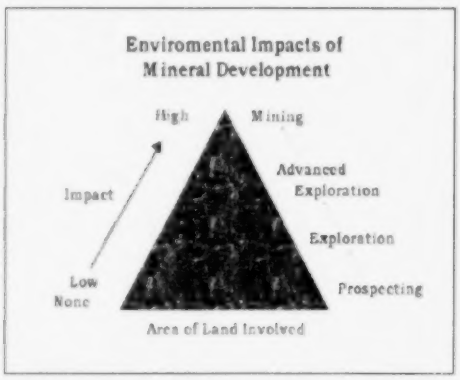
- Following the operating life, the next phase is preparing for closure (1 to 2 years) – much of the planning for closure begins in the early permitting phase and throughout the mine's operating life.
- Rehabilitation (1 to 4 years) replaces the site with equal or better land condition than prior to mining – this involves filling and grading, pit or mine stabilization, tailings impoundment reclamation, acid rock mitigation – reclamation bonds, are required to be put in place by mining companies to ensure rehabilitation achieves the pre-determined environmental objectives (e.g., wildlife habitat, visual quality, grazing areas, etc.)

2.0 RESOURCE SENSITIVITIES

- The business of the coal mining industry is to supply the metallurgical and thermal coal needed to produce the goods we use in our society (e.g., steel for Japanese cars) – at the same time, coal companies are obliged to protect the environment by meeting or surpassing environmental standards – climate change is a potential factor in meeting these challenges.[5]
- The nature of coal mining requires that land, air and water systems be temporarily disturbed – coal companies must find, extract and process coal with the least possible disruption to these systems.
- Mineral exploration and mining are permitted land use activities in all areas outside of provincial parks and protected areas, subject to applicable legislation and regulations.

2.1 Exploration and Production Land-Base

- Given the broad geographical dispersion of mineral deposits, large tracts of land must be available to the mining industry for exploration purposes.
- Although large areas of land are required for exploration, relatively small areas are required for a actual producing mine.
- In BC, less than 1/30th of 1 percent of BC's land base (about 28,000 hectares) is currently being used for mining (all types).[6]



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2.2 Sensitivities

➤ Depending on the location and conditions of the site the following sensitivities may apply.

Environmental	Economic	Social
➤ Ground disturbance, loss of tree and plant cover. ➤ Water use and discharges from surface erosion, product washing. ➤ Groundwater impacts. ➤ Fish and wildlife habitat impacts ➤ Global warming from energy use and gas emissions.	➤ First Nations rights. ➤ Trucks wear on roads serving the operation. ➤ Tourism and commercial recreational impacts.	➤ Community impacts – employment, spin-off business impacts. ➤ First Nation impacts (e.g., (trapping, potential employment) ➤ Visual aesthetics and recreational impacts ➤ Truck traffic on resource roads shared by others.

➤ Coal mines do not normally have any major social impacts, related to noise and vibration from blasting, crushing screening, back up alarms, visual aesthetics, dust from pit and trucks.

➤ Acid rock drainage is not a major concern at existing BC coalmines due to the generally low sulphur content in the coal deposits and adjacent host rock.

➤ Coal mining operations represent a temporary land use, and when operations are completed, reclamation can restore the land to its earlier condition and in some cases, create better quality land than what existed prior to the mine (e.g., improved wildlife habitat).

➤ For example, the Greenhills Coalmine, which is located 8 kilometers northeast of Elkford, was given the British Columbia Ministry of Energy and Mines' Outstanding Reclamation Work award in 2000. [7]

BC's Greenhills Coal Mine Near Elkford

3.0 INVESTMENT REQUIREMENTS

➤ Using the example of a large open pit coalmine, located about 70 km. from Tumbler Ridge, typical investment requirements have been broken down into the mine's life-cycle stages, based on a 20-year mine life, shown below.

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Development Phase	Costs
Commodity	Clean Metallurgical Grade Coal
Capacity	4 million tonnes/yr. 350 days/year
Operating Personnel	1000
Exploration and Development[a] ($ M)	$C14.4
Design and Construction ($ M)	$C385.0
Mine Operating (for 8:1 Strip Ratio)	$C23.00/tonne
Preparation Plant Operating	$C5.50/tonne
Admin – Operating	$C2.00/tonne
Total Operating Costs, FOR Mine ($/tonne)	$C30.50/tonne
Rail Fright Charges	$C18.00/tonne
Rail Surcharge	$C5.00/tonne
Port surcharge	$C6.00/tonne
Freight Costs, FOB, Port of Ridley	$29.00/tonne
Ongoing Capital Costs (Reoccurring 5 year cumulative cost)	
Tailings ($ M)	$C1.0
Mine Equipment ($ M)	$C60.0
Miscellaneous ($ M)	$C5.0
Total Ongoing Capital Costs ($ M)	$C66.00
Closure and Rehabilitation (One time in $ M))	$C5.00

➤ A general rule of thumb is that coalmine development costs are about $C100.00/tonne – that is, for a 4 million tonne/yr. coal mine, total installed cost would about $C400.0 million.

4.0 INFRASTRUCTURE

➤ The magnitude of a new 4.0 million-tonne/yr. coal mine requires major infrastructure investments, however if the new mine is built relatively close to operating or previously operating mines, infrastructure costs can be less and mine feasibility improved (i.e., close to power, rail, road, townsite).

4.1 Transportation Infrastructure

➤ The example mine will require a 70 km. all weather road to connect to the provincial road system – resource roads may exist, but will require upgrading – the upgraded roads will be used for the transportation of equipment, materials and consumables and personnel for both construction and operation.

➤ The new mine will require a connection to the existing BC Rail system – it is assumed that BC Rail will develop the rail line to the mine and

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recoup the capital investment through rail surcharges per tonne of coal transported – mine infrastructure will require the installation of a loop at the minesite and railcar loading facilities.

4.2 Power and Water

- The size and long-term commitment of a mine of this type will require construction of major power and water infrastructure – a high voltage power line will need to be constructed to the provincial power grid at Tumbler Ridge – water requirements will be met either by local wells or dams.

4.3 Access to Market

- Clean metallurgical coal is shipped by rail to either the Port of Ridley near Prince Rupert or to Vancouver for loading and shipment to the Japanese, South Korean or European steel markets.
- Referring to the project costs in the table above, the figures show that project economics are very sensitive to rail and port costs, given the location of the deposit and the distance to Pacific tidewater.
- Coal is one of the largest commodities moved by ships worldwide, and the single largest commodity carried by Canadian railways.

Ridley Island Coal Loading Facility

5.0 MARKET

5.1 Overview

- Coal is one of the major global and long-term energy resources; and is likely to continue so as long as economically exploitable coal reserves are widely available – about 20 per cent of Canada's electricity is generated by using coal (e.g., Alberta, Saskatchewan, Ontario, Nova Scotia).[9]
- Although the relative importance of coal has declined in industrialized countries (mainly as a result of the advent of oil and natural gas), still 36 percent of the world's electricity is generated from coal and 70 percent of world steel is produced using coal and coke – the use of coal for electricity generation in developing countries is expected to continue to increase.[10]
- Coal customers prefer low sulphur coal, as it reduces the amount of sulphur dioxide that the power and steel plants have to remove from their emissions.
- New technologies are being explored to produce hydrogen from coal – the hydrogen could be used in the emerging hydrogen economy – one example, is the use of hydrogen in fuel cells (e.g., the Ballard fuel cell) to produce clean electricity.

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5.2 Volumes and Values

- In 2001, BC metallurgical coal revenues were $1.5 billion (average price $62.40/tonne, FOB Ridley).[11]
- In 2001, BC thermal coal revenues were $51.5 million (average price $37.83/tonne, FOB Ridley).[12]
- Total net coal revenues for 2001 was $C962.00 million, which represents 37% of BC's total mining industry net revenues.[13]
- The long-term price for metallurgical coal is expected to be about $C61.00/tonne FOB, coastal port.

5.3 Marketing

- Marketing of the coal begins at the pre-feasibility and feasibility stages of mine development – often mining companies will enter into contracts with steel manufacturers to supply coal over the proposed life of the mine.
- Coal quality is of great importance to steel manufacturers – BC coal is generally considered a good quality medium volatile coking coal and is capable of replacing most of the world's best medium and low volatile coking coals in blends.
- Metallurgical coal is shipped from the mine by rail to Price Rupert or Vancouver for shipment to Japan, South Korea or Europe for use in their steel making industries.[14]
- Thermal coal is shipped from the mine by rail to Prince Rupert or Vancouver for shipment to Korea, Japan, Chile, Mexico and others – 25 percent of BC thermal coal is used in North America.[15]
- The "Asian Flu" depression (1997-98) of the Asian economies has affected metal and coal markets.

5.4 Value of Production

- For the typical mine, coal production would be 12,600 tonnes/day of processed coal (12,000-tonnes/day metallurgical coal, 600 tonnes/day thermal coal.
- The value of metallurgical coal @ US$46.00 /tonne, would be US$193 million, (FOB) Ridley.
- The value of thermal coal @ US$31.00 /tonne, would be US$6.5 million, (FOB) Ridley
- Given the mine in production operates 350 days/yr. – total revenue would be $C320.00 million/yr.

6.0 LABOUR MARKET

- During mine construction it is likely that construction personnel would be brought into the site by busses from existing towns, such as Tumbler Ridge.
- The labour requirements for a large coalmine (4.0 million tonnes/yr.) can be as many as 1,000 workers.

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- Generally, skilled workers are required for the operation and maintenance of the mine – new mines have a high degree of automation and process control, requiring fewer, but more highly skilled operators than in the past.
- Several mining companies are investigating the implementation of remotely operated truck fleets and other mining equipment – this will decrease operator requirements and improve safety by removing personnel from dangerous locations.
- Large coalmines are designed to operate for an average of 350 days/yr.
- The average BC worker in the mining industry earns $C81,000/yr.[16]

6.1 Example Mine Development

- Exploration and Development – 5 to 10 years (surveying, diamond drilling, metallurgical testwork, pre-feasibility study, bulk sampling, feasibility study, pilot plant, environmental assessment studies and permitting, planning and approvals) requires a diversity of technical skills.
- Mine and plant construction – 3 years for open pit pre-stripping, 100 workers for 6 months, and process plant 500 workers for 3 years.
- Operation – 20 years requiring 1000 workers.[17]
- Closure – 2 years dismantling requiring 60 personnel for 6 months and closure preparation requiring 30 personnel for 24 months – Rehabilitation – 4 years requiring 30 workers.
- Total direct employment (excluding exploration and development), for a 20-year coalmine of this scale would be a total 21,750 person-years (expressed as an annual average 750 jobs for 29 years).

6.2 BC Employment

- Estimated coal mining employment by region is provided below, along with indirect (e.g., spin-off) employment.

Region	Workers
Kootenay	2,338
Okanagan	0
North Coast	0
Coast	230
Nechako	0
Northeast	222
Direct Employment	2,790
Indirect Employment[18]	2,085
Induced Employment	1,127
Total Employment	**6,002**

- Although, direct coal mining employment in BC is estimated to be 2,790 workers, with the addition of indirect and induced employment, total employment is estimated to be about 6,000 workers.[19]

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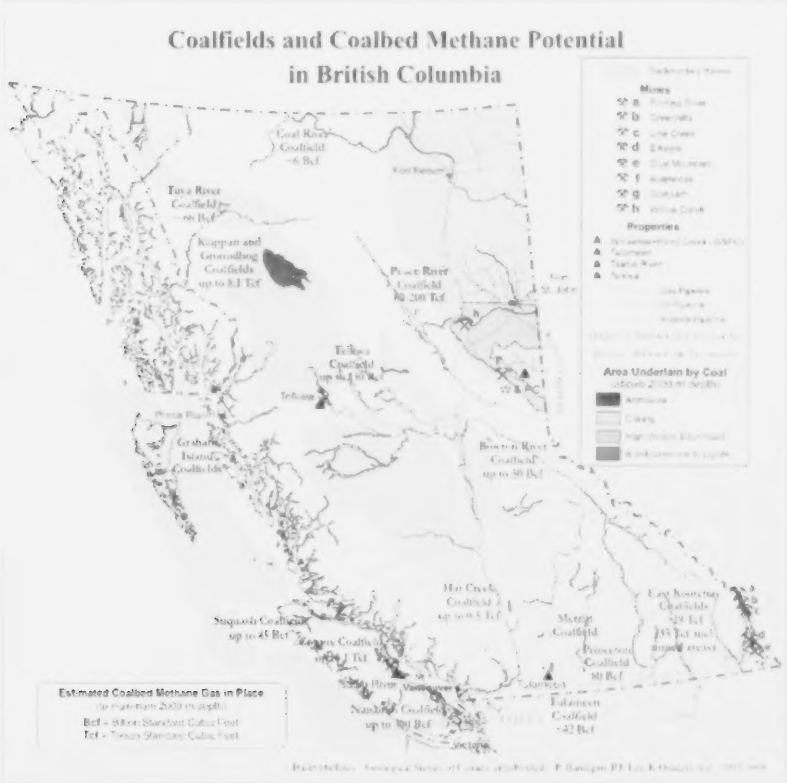
7.0 CAPACITY

7.1 Future Potential

- Coal is the world's most abundant fossil fuel and is second only to oil as a world energy source – Canadian coal deposits contain more energy than all the country's oil, natural gas, and oil sands combined.[20]
- BC's estimated ultimate coal resource available for surface or shallow underground mining is over 20 billon tonnes (the coal resource for coal bed methane is estimated to be 250 billon tonnes).[21] – BC's major coalfields are shown in the map below.[22]


Coalfields and Coalbed Methane Potential
in British Columbia
Mines
Properties
Area Underlain by Coal
Estimated Coalbed Methane Gas in Place
Bcf = Billion Standard Cubic Feet
Tcf = Trillion Standard Cubic Feet
Coal River Coalfield ~6 Bcf
Tuya River Coalfield ~66 Bcf
Klappan and Groundhog Coalfields up to 8.1 Tcf
Peace River Coalfield up to 200 Tcf
Telkwa Coalfield up to 1.65 Tcf
Telkwa
Graham Island Coalfields
Bowron River Coalfield up to 50 Bcf
Hat Creek Coalfield up to 0.5 Tcf
Suquash Coalfield up to 45 Bcf
Nanaimo Coalfield up to 300 Bcf
Merritt Coalfield
Princeton Coalfield 50 Bcf
Tulameen Coalfield ~42 Bcf
Elk Valley Coalfield 35 Tcf in-place resource
Vancouver

- The majority of the coal deposits are found in the foothills of the Rocky Mountains – folding and faulting with subsequent glaciation and erosion of lower Cretaceous strata has resulted in elongated ridges being formed along the general northwest trend of the geological structures.
- Future coal mine development will likely occur in regions that have infrastructure and good deposits, such as the Northeast, East Kootenay, and Vancouver Island
- The major coalfields in BC, including those in the Interior and on the Coast, are listed below.

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Type	Location	Area
		(km.^{2})
Rocky Mountain Belt		
East Kootenay	Flathead, Crowsnest, Elk Valleys Coalfields	
Northeast	Bullmoose, Quintette, Sukunka, Willow Creek	400 km (length)
Coastal (Insular)		
Graham Island	Northern Graham Island, Queen Charlotte Islands	
Suquash	Northeast Vancouver Island,	105
Comox	Eastern Vancouver Island e.g., Quinsam Coal)	2,000
Nanaimo	Nanaimo area	1300
Interior(Intermontane)		
Klappan Groundhog	Northeast of Stewart, BC	2,300
Telkwa	Near Smithers, BC	N/A
Bowron River	Central Interior	47.5
Similkameen	Tulameen and Princeton 170 km^2	170
Merritt	Near Merritt, BC	105
Hat Creek	Between Cache Creek and Lillooet	104
Tuya River	North Klappan	200
Coal River	Alaska Highway, Northwest Ft. Nelson	35

8.0 REGULATORY REGIME

8.1 Provincial Approvals

- The *Environmental Assessment Act* established BC's environmental review process, coordinated by the Environmental Assessment Office, which reviews the potential environmental, social, economic, cultural, and heritage impacts of large-scale development projects.
- Reviewable projects include metal, mineral coal and placer mines, aggregate operations, and industrial quarries, in addition to related processing of primary metals, minerals and mineral products and manufacturing (cement, glass, lime and asbestos).
- The BC environmental review process accommodates simultaneous review of the required permits and licences – application of permits and licences may need to incorporate detailed engineering design information, which may be difficult to justify without first approving approval-in-principle through environmental assessment approval.
- Provincial statues and regulations[23] that apply to coal operations, include: the *Coal Act*, the *Mines Act* (Health, Safety and Reclamation Code), *Forest Land Reserve Act*, *Forest Act*, *Range Act*, *Forest Practices Code Act*, *Soil Conservation Act*, *Agricultural Land Reserve Act*, *Land Act*, *Highway Act*, *Water Act*, *Heritage Conservation Act*, *Environmental Assessment Act*, *Fish Protection Act*, *Waste Management Act*, *Wildlife Act*.
- Timelines for the government portion of BC environmental assessment review is set out in regulation – the length of the review process depends on the complexity of the issues and could range from 12 to 30 months, or longer if a public hearing is required.

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8.2 Federal Approvals

- When a large-scale project triggers the *Canadian Environmental Assessment Act*, the BC and Federal governments have agreed to co-operate in a joint review process — at the end of a Federal-Provincial review, each government makes a separate decision on the project.
- Federal involvement can be triggered when projects require interprovincial or international or federal approvals, or which receive federal financial assistance, or involve federal lands.
- Federal statues and regulations[24] that may apply, include: the *Fisheries Act*, *Canadian Environmental Assessment Act*, the *Navigable Waters Protection Act*, *Canadian Environmental Protection Act*, *Migratory Birds Convention Act*, *Canada Wildlife Act*.

8.3 Local Approvals

- If a coalmine operation is located in a local government jurisdiction, they can affect operations through application of local bylaws that can affect operating conditions.
- If a new mine is located near an existing community, the boundaries are often enlarged in order to capture a new tax base for the benefit of the local community.

9.0 GOVERNMENT REVENUES

- Mining companies are subject to fees and taxes, similar to other businesses – the main additional charges are mining and mineral taxes.
- The following table lists the various local, provincial and federal taxes and levies paid by the surveyed companies representing the BC mining industry – coal mining is included and represents 37 percent of BC's net revenues, the share of which if applied to the total government revenue figure amounts to about $125 million.[25]

Component	Government Revenues
	($ million)
Local Taxes	
School Tax	10.0
Municipal Finance Authority	12.0
Rural Area Levy	8.0
Other Levies	**12.0**
Sub-Total	**42**
Provincial	
Corporate Income Tax	34.0
Employee Income Taxes ($81k/worker, 7,630, 7%)	43.2
Mining Taxes	7.0
Mineral Tax	25.0
Capital Tax (Phased out)	7.0
Provincial Sales Tax (7.5%)	34.0
Fuel tax	9.0
Other	3.0
Sub-Total	**162.2**

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Component	Government Revenues
Federal	
Employee income taxes ($81k/worker, 7,630, 14%)	86.5
Corporate Income taxes	30.0
Goods and Service Tax and Other	16.0
Sub-Total	132.5
Total	**336.7**

10.0 INPUT-OUTPUT TABLE

10.1 Value Coefficients

- BC was second only to Alberta coal production, producing 40 percent of Canada's total production.[26]
- According the BC Mining Association, mining an ore body in BC represents the highest value to which a hectare of resource land could be put.[27]

Resource Land Use	Value
Gross Annual Value	($/hectare)
Mining	$150,000
Forestry	$5,700
Agriculture	$1,400
Parks and Recreation	$42.00

- In total, less than 0.03 percent on BC's land base is used for mining (i.e., 28,000 hectares) – this compares to about 200,000 hectares *per year* that was harvested by the forest industry in 1996-97.[28]
- Over the last 10-years two mines have closed for every new mine that has opened [29]

10.2 Employment Coefficients [30]

- As shown below, the BC Input-Output Model estimates the direct coal mining employment to be 2.97 jobs per $1,000,000 in revenues – with the inclusion of indirect employment (e.g., spin-offs), total employment amounts to 6.39 worker per $1,000,000 in revenues.

Employment/million sales /yr at pit	Direct	Indirect	Induced	Total
Coal Mines	2.97	2.22	1.20	6.39
Service Incidental to Mining	7.89	2.41	2.09	12.39

- Direct Employment – is the employment associated with the direct activity.

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- Indirect Employment – is the employment generated within the BC economy from suppliers of the materials (goods and services) required to produce the primary product.
- Induced Employment – is generated from the suppliers paying out wages to their employees, which are then respent in the economy (net of savings and taxes).
- Total Employment – is the sum of this total economic activity, (i.e., direct and spin-off impacts) composed of three components (direct, indirect and induced).

10.3 Labor and Capital Intensity

- The employment coefficients above reflect the relative labour intensity of the industrial mineral activity – the low labour intensity of coal mines reflects the higher capital intensity in the industry – this results in higher labour productivity which supports the high wage rates typical of the industry (e.g., $81,000/yr. BC average).
- Firms attempt to equalize the productivity from both capital and labour, which allows them to stay competitive and sustain operations (e.g., protect employment) during the ups and down of the commodity price cycle.

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SOURCES OF INFORMATION

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[1] This Building Block is one of five prepared under the *Minerals, Coal and Aggregates Building Block* heading, which covers Construction Aggregates, Industrial Minerals, Metal Mines, Coal (excluding coal bed methane) and High Valued Opportunities.

[2] http://www.coal.ca/coalstats.htm

[3] http://www.em.gov.bc.ca/Mining/Geolsurv/EconomicGeology/coal/coalinbc/coal_bc96.htm

[4] http://www.teckcominco.com/news/tek-archive/2000/00-04-T.html

[5] The Kyoto Protocol calls for a reduction in greenhouse gas (GHG) emissions to 7% below 1990 levels by the period 2008-2012. The Kyoto Protocol specifies carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N2O), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), and sulfur hexafluoride (SF_6) as the GHGs for which emissions should be reduced. CO_2 which is emitted from the combustion of fossil fuels (e.g., coal) is the most significant because of the large tonnages emitted.

[6] Mining Association of BC http://www.mining.bc.ca/quickfacts.htm

[7] http://www.fording.ca/cache/page_239.html

[8] File Note: Personnel communication from john Tully, P.Eng. 30th October 2002. Re: Exploration Costs

[9] National Energy Board. http://www.neb.gc.ca/energy/emaelect_e.pdf

[10] http://www.grida.no/climate/ipcc_tar/wg3/359.htm

[11] British Columbia Ministry Mines and Energy – 2001 Markets for Metallurgical Coal http://www.em.gov.bc.ca/Mining/MiningStats/32coalmet.htm

[12] British Columbia Ministry Mines and Energy – 2001 Markets for Thermal Coal http://www.em.gov.bc.ca/Mining/MiningStats/32coalther.htm

[13] The Mining Industry in British Columbia - 2001 – Price Waterhouse Coopers

[14] British Columbia Ministry Mines and Energy – 2001 Markets for Metallurgical Coal. http://www.em.gov.bc.ca/Mining/MiningStats/32coalmet.htm

[15] British Columbia Ministry Mines and Energy– 2001 Markets for Thermal Coal http://www.em.gov.bc.ca/Mining/MiningStats/32coalther.htm

[16] The Mining Industry in British Columbia - 2001 – Price Waterhouse Coopers

[17] 2001 Mining Sourcebook – Canadian Mining Journal and Feasibility Study for 4 million tonnes per year open pit coal mine. Prepared by Fluor Daniel Wright for Confidential Client.

[18] BC Ministry of Finance and Corporate Relations (2001), ***British Columbia Provincial Economic Multiplies and How to Use Them***. Other Non-Metal Mines, Large Aggregation. This multiplier chosen as an average.

[19] Derived from the ***The Mining Industry in British Columbia - 2001*** – Price Waterhouse Coopers and http://www.em.gov.bc.ca/Mining/MiningStats/33employcoal.htm

[20] http://www.coal.ca/class.htm

[21] http://www.em.gov.bc.ca/Mining/Geolsurv/EconomicGeology/coal/coalinbc/coal_bc96.htm

[22] http://www.em.gov.bc.ca/DL/Coal/CoalfieldMap.pdf

[23] Provincial statutes http://www.qp.gov.bc.ca/statreg/

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[24] Federal statutes http://laws.justice.gc.ca/en/index/index.html

[25] PriceWaterhouseCoopers The Mining Industry in BC – 2001. http://www.mining.bc.ca/download/mibc_2001.pdf, Appendix 21

[26] http://mmsd1.mms.nrcan.gc.ca/mmsd/production/2001.pdf

[27] http://www.mining.bc.ca/quickfacts.htm. According to the Lorne Grasely of the BC Mining Association (604.681.4321, local 116), this statistic reflects gross annual revenue per hectare.

[28] BC Ministry of Forests ***1997/98 Annual Report***. Page 90.

[29] BC Mining Association, Quick Facts About Mining. According to the Lorne Grasely of the BC Mining Association (604.681.4321, local116), this statistic was estimated about 5-years ago (e.g. 1997).

[30] BC Ministry of Finance and Corporate Relations (2001), ***British Columbia Provincial Economic Multiplies and How to Use Them.*** Large Aggregation Industries, Induced assumes "with Safety Net".

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